

An innovative pot system for monitoring the effects of water stress on grapevines and grape quality

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The pot system

The pot system is located at the Research Unit for Viticulture of CREA in Arezzo (Italy). The system consists of 99 pots of 70 liters, with 3 soils of different texture (Fig.1), from real vineyards of the Chianti Classico region (Tuscany). The vines, Pinot Noir clone ENTAV 115, are both grafted, on 1103 Paulsen (PAU) and on 101-14 (101), and ungrafted (FRA).

All the combinations soil-rootstock are repeated 9 times.

The pots are equipped for drip irrigation and with sensors to monitor soil and weather parameters (Fig.2).

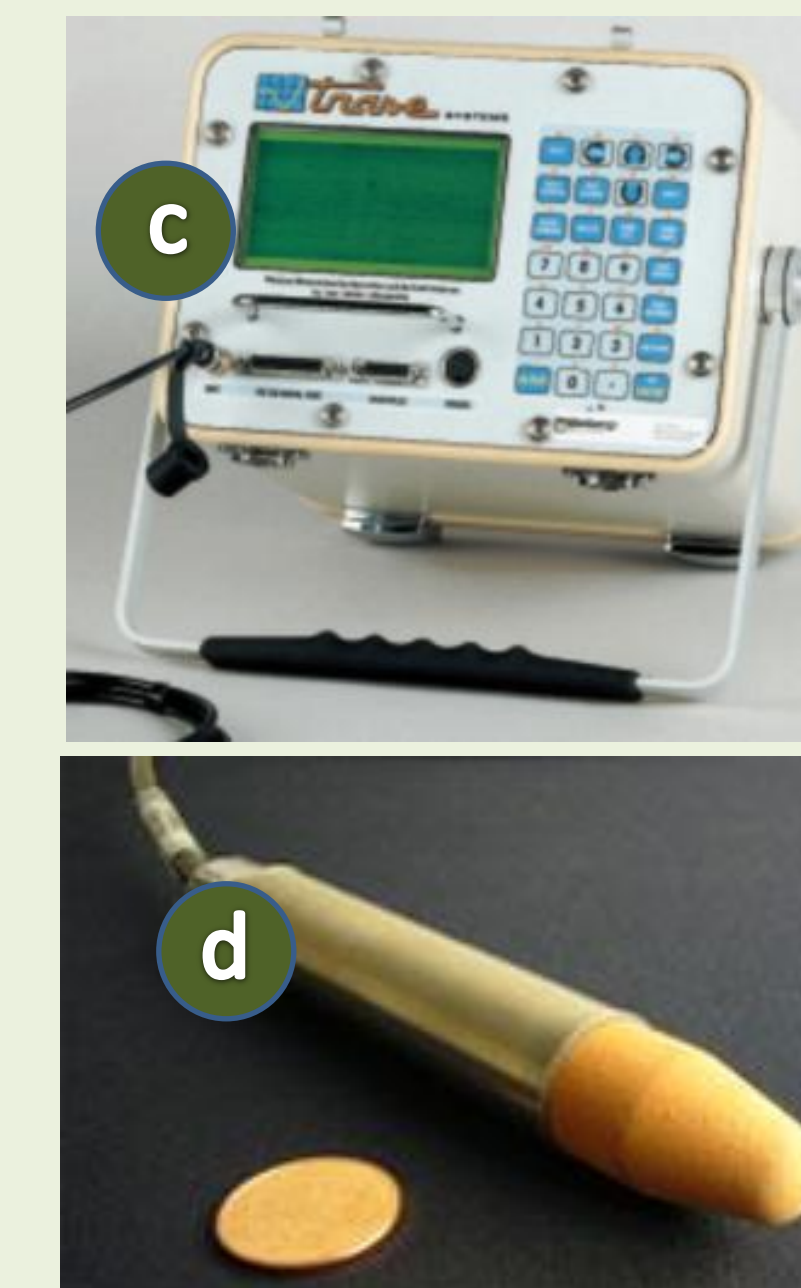
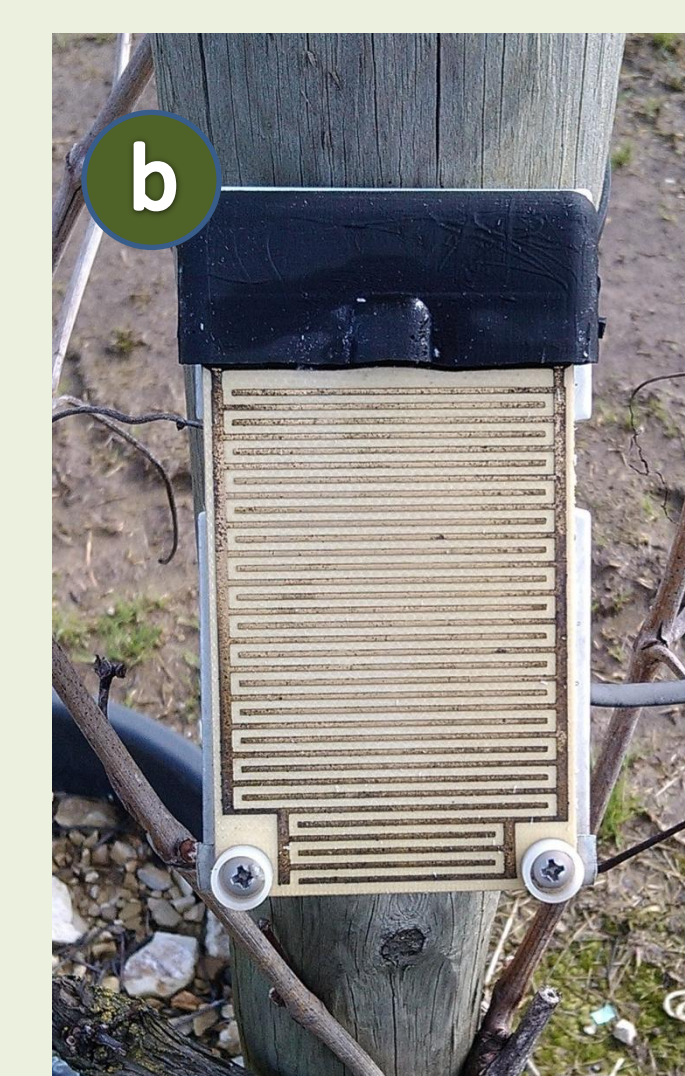
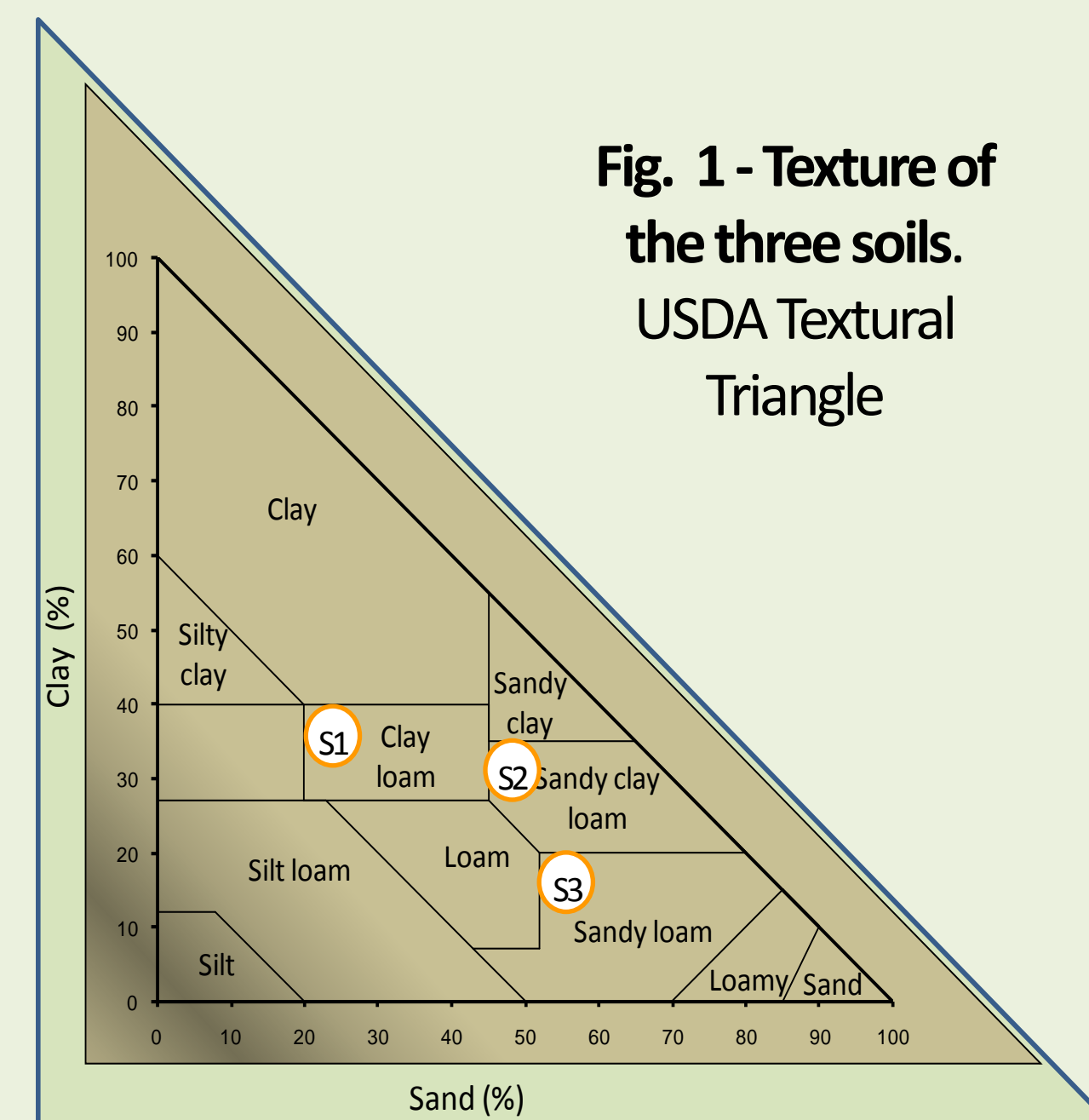


Fig. 2 - Instruments and sensors. Data logger (a) to record soil water potential and temperature of the 9 calibration pots, air temperature and rainfalls once per hour. Soil water potential is measured by pF-Meter (Ecotech GmbH, Bonn, Germany). Three pF sensors for each soil typology were used to calibrate the volume-tension curves. Volumetric content of water into the soil is determined with Time Domain Reflectometer (TDR) (c). Leaf wetness sensor (Netsense, Florence, Italy) for monitoring leaf moisture for plant pathology studies (b).

System application

Irrigation protocol	Water supply
W0	Three times a week to field capacity.
W1	1 L three times a week, irrigation to reach field capacity if severe plant withering occurred.
W2	2 L three times a week, irrigation to reach field capacity if severe plant withering occurred.

In July 2015 three different irrigation protocols were tested for a period of 5 weeks (up to veraison) in order to study the effect of water stress on vines physiology and on grapes quality. After this period all the pots were irrigated abundantly and frequently until complete ripening of the grapes (25 August).



Results

The weather conditions during the testing period showed high temperatures and large temperature range. The different water supply influenced soils moisture. S1 kept higher percentage of water, higher leaf water potentials and chlorophyll contents (Fig. 3). Plant production and berry size were reduced by water stress conditions. The accumulation of sugar and organic acids were more efficient in the plant with higher water availability (Fig. 4). The phenolic compounds (anthocyanins and polyphenols) were more abundant in the grapes from vines under water stress conditions but there was a positive correlation between the amount of anthocyanins synthesized per berry and the soil water content (Fig. 5). The rootstock influenced the plant response to water stress. 1103 Paulsen allowed the vines to keep higher level of chlorophyll and favored the synthesis of the anthocyanins in all conditions.

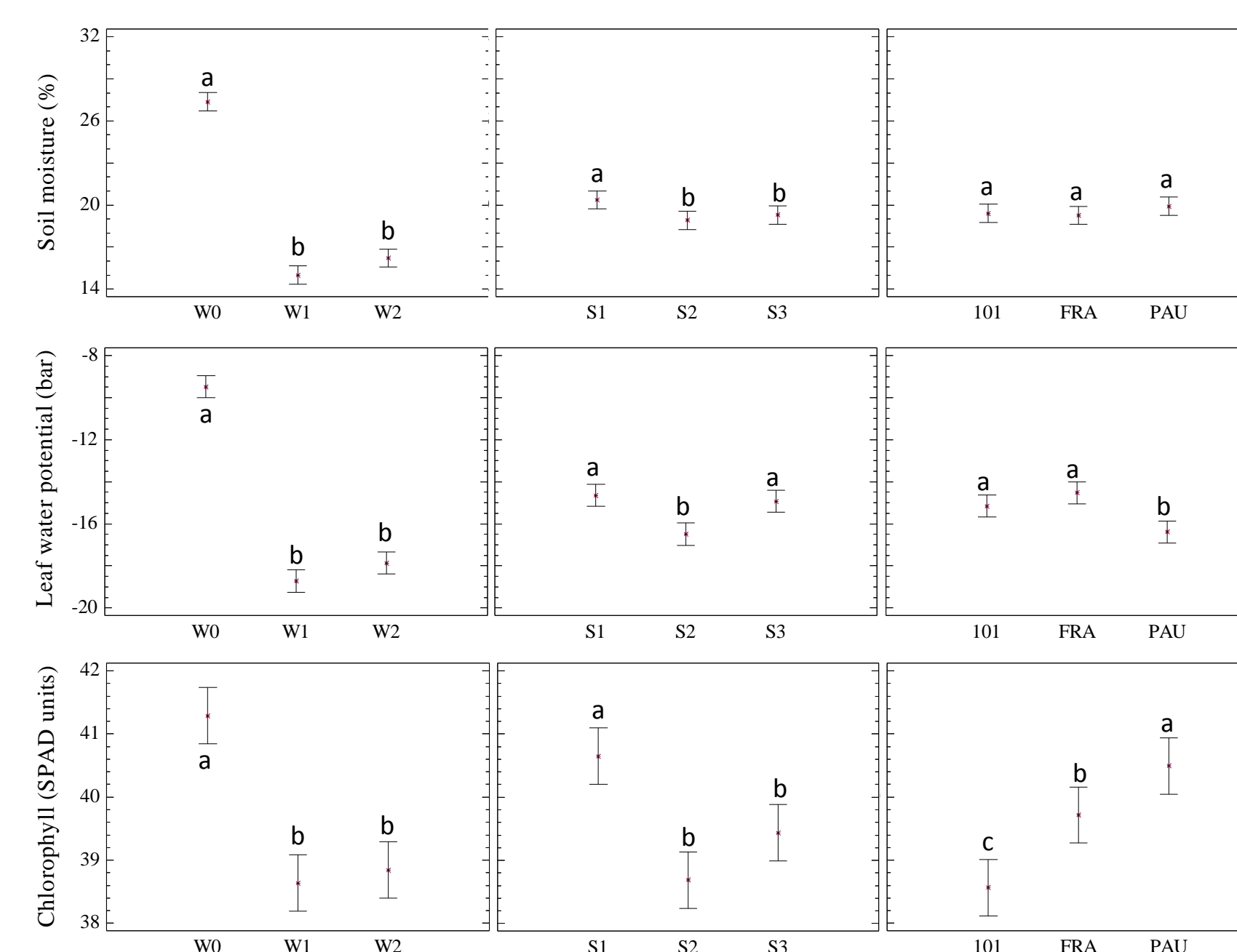


Fig. 3 - Quantity and technological parameters of grapes

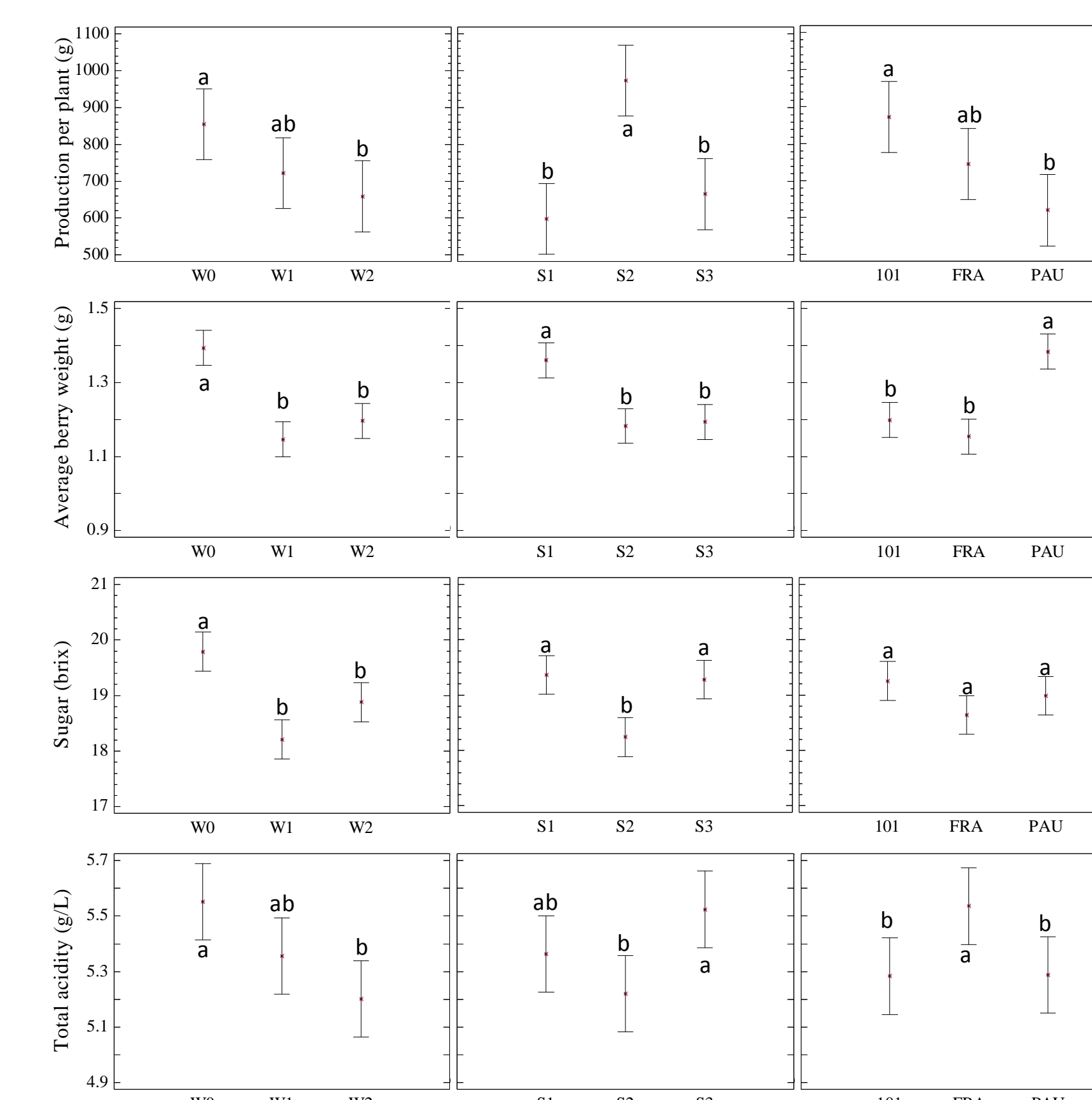


Fig. 4 - Soil moisture and physiological parameters of grapevines

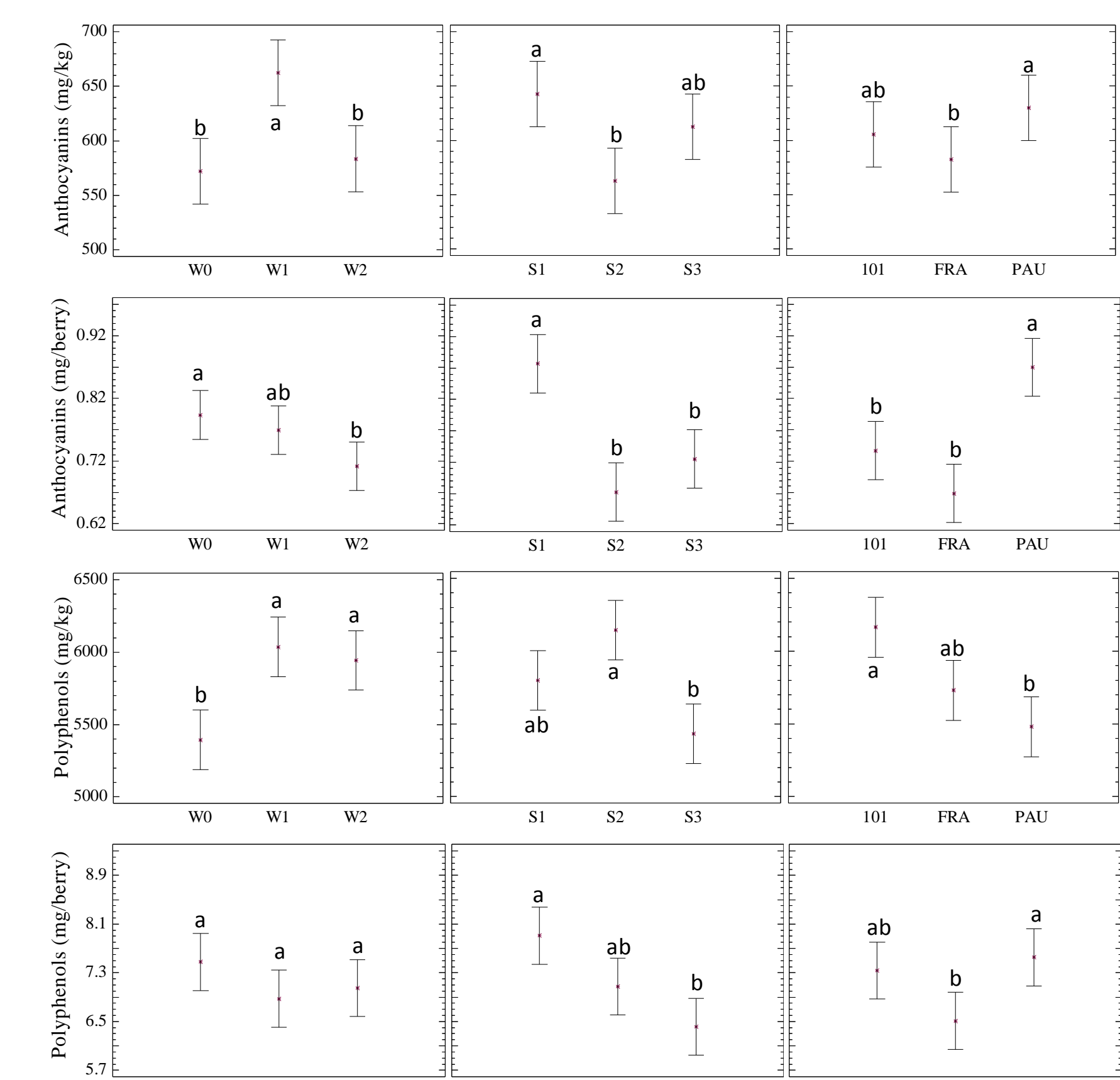


Fig. 5 - Phenolic composition of grapes

Conclusions

The results revealed that a period of water stress during the early stages of growth of the bunches can induce irreversible changes in the physiology of the plant. The pot system allowed, by controlling many variables and factors with a suitable number of replicates, to obtain statistically significant results in only one year of experimentation.

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Project RINGO -Rootstock-scion Interaction in Grape: an Omics perspective